Undergraduate Catalog of Courses

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Environmental and Earth Science Programs

Saint Mary's College of California

ENVIRONMENTAL AND EARTH SCIENCE PROGRAMS

The Environmental and Earth Sciences (EES) programs provide students with foundational knowledge from many disciplines. This knowledge is then applied to the study, management, and conservation of the environment and living systems around us. Students examine the structure, function and dynamics of ecosystems, the interaction between biotic and abiotic systems, and explore how human enterprise is adversely affecting our global environment. Students examine how environmental degradation and pollution can be lessened or prevented by the application of conservation and management principles derived from ecological theory. Our students work towards a deep understanding of the natural world around them, while at the same time acquiring practical skill sets useful for addressing the serious environmental issues with which we as a society are faced. Our degree programs foster deep critical thinking and scientific understanding and offer a range of heuristic approaches to addressing environmental issues that span from the natural sciences to aspects of the social sciences and humanities.

The location of Saint Mary's College, on the cusp between the urban centers of the Bay Area and the more rural setting of the coast range and the Central Valley provide unique opportunities for our students. Due to our location we have easy access to freshwater systems, (streams, wetlands, etc.), the Sacramento San Joaquin Delta, the coast range mountains, mixed oak woodland forests, and chaparral communities. Some of our students are also able to take advantage of internships in a variety of fields due to our proximity to the greater San Francisco Bay Area..

FACULTY

Roy Allen, PhD, *Professor of Economics (Natural Resource Economics and Human Ecology)*
Steven Bachofer, PhD, *Professor of Chemistry (Environmental Chemistry)*
Alice Baldridge, PhD, *Associate Professor of Geology (Geosciences, Hydrology, Remote Sensing)*
Carla C. Bossard, PhD, *Professor of Biology (Plant Science, Ecology, Terrestrial Systems)*
Joel Burley, PhD, *Professor of Chemistry (Atmospheric Chemistry, Environmental Chemistry)*
John Ely, PhD, *Associate Professor of Sociology (Society and the Environment)*
Rebecca Jabbour, PhD, *Associate Professor of Biology (Evolution, Genreal Biology)*
Alex LaGatta, PhD, *Adjunct Professor of Geology (Geosciences, Environmental Science and Energy)*
Gretchen Lemke-Santangelo, PhD, *Professor of History (U.S. Environmental History)*
Michael P. Marchetti, PhD, *Fletcher Jones Professor of Biology (Conservation Biology, Aquatic Ecology, Invasive Species)*
Asbjorn Moseidjord, PhD, *Professor of Economics (Environmental Economics)*
Ron Olowin, PhD, *Professor of Physics and Astronomy (Geosciences, Environmental Modeling, Astronomy)*

LEARNING OUTCOMES

When students complete the Environmental Science and Studies programs, they will be able to:

- RECALL and synthesize the the knowledge derived from biology, chemistry, physics, earth science, economics and political science to better understand the earth's environment.
- COMPREHEND environmental problems from multiple perspectives.
- EVALUATE the credibility of varying sources of information on environment.
- DISPLAY cognizance of ethical considerations and be mindful of them when constructing solutions to environmental problems.
- RECOGNIZE the interconnectedness of earth's ecosystems and human dependence on them.
- COMMUNICATE environmental findings through seminars, written scientific reports and visual presentations.
- KNOW how to access information on environmental topics from library sources, original scientific literature and the Internet.
- DEMONSTRATE competence in using the basic equipment used to gather information on the environment.
- RECOGNIZE processes and patterns of environmental interactions.

CURRICULUM AND COURSE REQUIREMENTS
Two degrees are offered. A bachelor of science (BS) in Environmental Science and a bachelor of arts (BA) in Environmental Studies. The bachelor of arts program involves less scientific rigor than the bachelor of science. Three minors are also offered in Environmental Science, Environmental Studies and Earth Sciences. All environmental science and studies majors will also be required to do either a research internship or a senior research thesis (such as the ongoing summer research program in the School of Science) or a senior project.

ENVIRONMENTAL SCIENCES MAJOR (BS)

Required: 16 courses plus a senior project

SEVEN REQUIRED LOWER DIVISION COURSES
EES 40/41 Physical Geology or
EES 50/51 Historical Geology
CHEM 8/9 General Chemistry 1
CHEM 9/10 General Chemistry 2
MATH 27 Calculus 1
BIO 1 Cell, molecular and genetics
BIO 2 Organisms – evolution
PHY 10/20 General Physics for biologists

FIVE REQUIRED UPPER DIVISION COURSES
EES 100 Hydrology
BIO 119 Research Design and Biostatistics
or **MATH 113 Probability and Statistics,**
or equivalent
ECON 150 Environment and Natural Resources Economics
POL 135 Environmental Politics
or **POL 136 Environmental Law**
BIO 125 General Ecology

FOUR UPPER DIVISION ELECTIVES
FROM THE FOLLOWING
EES 110 Introduction to GIS/Remote Sensing
EES 140 Environmental Geology/Natural Disasters
EES 150 Environmental and Physical Geology of the Parks
EES 160 Earth Materials
EES 175 Wetlands
EES 180 Sedimentology and Stratigraphy
EES 195 Internship
EES 197 Independent Study
BIO 113 Aquatic/Marine Biology
BIO 142 California Flora and Communities
BIO 144 Botany
BIO 152 Conservation Biology
CHEM 119 Environmental Chemistry
CHEM 104 Organic Chemistry 1
CHEM 106 Organic Chemistry 2

Senior Project (.25)
EES 196 Senior project

ENVIRONMENTAL STUDIES MAJOR (BA)

Required: 14 courses plus a senior project

FIVE REQUIRED COURSES
BIO 50 General Biology
BIO 125 General Ecology
ECON 150 Environment and Natural Resources Economics
POL 135 Environmental Politics
or **POL 136 Environmental Law**
EES 100 Hydrology

SELECT THREE LOWER DIVISION ELECTIVES
FROM THE FOLLOWING, INCLUDING ALL LABS
MATH 4 Statistics and Probability
EES 40/41 Physical Geology/Lab
EES 50/51 Historical Geology/Lab
EES 60/61 Urban Environmental Issues/Lab
PHY 40 Physics/Lab
EES 92/93 Environmental Science/Lab
BIO 34 Protecting Biodiversity

SIX UPPER DIVISION ELECTIVES
FROM THE FOLLOWING, INCLUDING LABS
PHIL 130 Environmental Ethics
HIS 155 Environmental History of Latin America
SOC 135 Society and Environment
POL 136 Environmental Law
JCL 130 Environmental Responsibility
EES 110 Introduction to GIS/Remote Sensing
EES 140 Environmental Geology/Natural Disasters
EES 150 Environmental and Physical Geology of the Parks
EES 175 Wetlands
EES 180 Sedimentology and Stratigraphy
EES 195 Internship
EES 197 Independent Study
BIO 113 Aquatic/Marine Biology
BIO 119 Research Design and Biostatistics
BIO 142 California Flora and Communities
BIO 144 Botany
BIO 152 Conservation Biology

Senior Project (.25)
EES 196 Senior project

Those who do not meet the prerequisite courses will need permission of the instructor.

EARTH SCIENCE MAJOR (BS)

Required: 16 courses plus a senior project

LOWER DIVISION CORE COURSES
EES 40/41 Physical Geology
ESS 50/51 Historical Geology
BIO 50/51 General Biology
CHEM 8/9 General Chemistry
CHEM 10/11 General Chemistry II
MATH 27 Calculus I
MATH 28 Calculus II
PHY 10/20 General Physics

UPPER DIVISION CORE COURSES
EES 100 Hydrology
EES 110 Intro GIS/Remote Sensing
EES 160 Earth Materials
EES 180 Sedimentology/Stratigraphy

Select five of the following courses:
EES 140 Environmental Geology/Natural Disasters
EES 150 Environmental and Physical Geology of the Parks
EES 175 Wetlands
EES 190 Structural and Regional Geology
EES 195 Internship
EES 197 Independent Study
CHEM 119 Environmental Chemistry
BIO 125 General Ecology
ECON 150 Environmental and Natural Resources
POL 135 Environmental Politics
or **POL 136 Environmental Law**
BIO 119 Research Design and Biostatistics

Senior Project (required)
EES 196 Senior Project (.25)

ENVIRONMENTAL SCIENCE MINOR

Choose two lower division courses

EES 92 Environmental Science
BIO 50 General Biology
EES 40/41 Physical Geology
or **ESS 50/51 Historical Geology**
EES 60 Urban Environmental Issues

Choose four upper division courses
EES 100 Hydrology
EES 110 GIS
EES 113 Marine Biology
EES 175 Wetlands
BIO 119 Research and Biostatistics
BIO 125 General Ecology
BIO 142 Cal Flora
BIO 144 Botany
BIO 152 Conservation Biology

ENVIRONMENTAL STUDIES MINOR

Choose two lower division courses

EES 92 Environmental Science
BIO 50 General Biology
EES 40 Physical Geology
EES 60 Urban Environmental Issues

Choose four upper division courses
BIO 125 General Ecology
BIO 152 Conservation Biology
ECON 150 Natural Resource Economics
POL 135 Environmental Politics
POL 136 Environmental Law
EES 100 Hydrology
EES 110 Introduction to GIS/Remote Sensing

EARTH SCIENCE MINOR

Take three lower division courses

EES 40 Physical Geology
EES 50 Historical Geology
EES 92 Environmental Science

Choose three upper division courses
EES 100 Hydrology
EES 110 Introduction to GIS/Remote Sensing
EES 175 Wetlands
EES 140 Natural Disasters
ECON 150 Natural Resource Economics

One of the following
EES 160 Earth Materials
EES 180 Sedimentology/Stratigraphy

COURSES

LOWER DIVISION

40 Physical Geology
Nature and distribution of earth materials, the processes by which the materials are formed and altered, and the nature and development of the earth. The introductory course in the earth science sequence offered every fall term. *This course satisfies the Scientific Understanding requirement of the Core Curriculum.*

50 Historical Geology
Principles of interpretation of earth history. Study of plate tectonics and sea-floor spreading as related to the development of continents, ocean basins and mountain belts. Origin, evolution and diversification of life through time. The second introductory course in the earth science sequence offered in the spring term. *This course satisfies Scientific Understanding of the Core Curriculum.*

60 Urban Environmental Issues
A general education science course that serves the ESS program as a lower division chemistry course. This course focuses on the environmental issues of redevelopment of Superfund sites. The course has been taught as a learning community linking it with another sociology course. This Learning Community has had a significant community outreach component studying the redevelopment of Alameda Point, formerly NAS Alameda. The chemistry curriculum is presented in context evaluating the environmental risks and the technologies applied to clean up the site. *Lab fee $175. This course satisfies the Community Engagement requirement of the Core Curriculum.*

75/175 Wetlands
Wetlands was designed to enable non-science major students to experience science as a way of knowing. Students study the environmental and organismal characteristics of various ecosystems which have soil covered with water at least part of the year. They study the biotic and abiotic factors that make wetlands unique. By examining the hydrology and biogeochemistry of fresh and salt water marshes, swamps, mangroves, bogs, vernal pools and peatlands, students come to understand the ecological and economic values of wetlands and about the threat to their continued existence. Students needing this course as an upper division requirement may petition for it to count as **EES 175.** *The upper division course will require significant additional work and assignments. This course satisfies the Scientific Understanding requirement and the Community Engagement requirement in the Core Curriculum. Lab fee $175.*

92 Introduction to Environmental Science
The entry level course reviewing the field. Physical, chemical, biological, geological and cultural dimensions of environmental problems are examined in this course. It surveys the historical roots of these problems, then considers components such as population pressure, air and water pollution, global change, desertification, deforestation et al. An introduction to ecological principles is provided. *This course satisfies the Scientific Understanding requirement and the Common Good requirement of the Core Curriculum.*

UPPER DIVISION

100 Hydrology
The hydrologic cycle, from precipitation, evapotranspiration, infiltration and runoff, to surface and groundwater. Hydrograph analysis, stream gaging and discharge determination. Groundwater occurrence, movement and evaluation. Hydrologic regions of U.S., emphasizing the western states. *Prerequisite: Area B math in the pre-2012 general education requirements or* **Math 4** *OR* **Math13** *OR* **Math 27.** *Lab and field trip(s).*

110 Introduction to GIS/Remote Sensing
Use of Geographic Information Systems (GIS) for interpretation of spatial data and preparation of maps. Display and manipulation of vector and raster data, including point locations, street maps, boundaries and satellite images. Map scale, projections, and coordinate transformations. Basic database queries. Principles of Global Positioning Systems (GPS). The course will include examples from several disciplines. *Lab and field trips.*

140 Environmental Geology/Natural Disasters
The interaction between geologic processes and human society. Topics include rock, mineral, water, and energy resources, volcanic hazards, earthquakes, landslides, floods, erosion, coastal processes, plate tectonics, geologic time, pollution problems and environmental management. *Prerequisite:* **EES 40** *OR* **EES 50** *OR permission of instructor. Lab.*

150 Environmental and Physical Geology of the Parks
This course explores the both the geologic processes that have shaped the parks and the environmental issues that created a need to manage public lands and that affect the parks today. The laboratory for this course includes field trips to several local national, state, and regional parks, including two overnight camping trips to experience these topics firsthand. *Prerequisites:* **EES 40** *OR* **EES 50** *OR permission of instructor. Lab and field trips.*

160 Earth Materials
Principles of mineralogy, crystal symmetry, structure and chemistry. Characteristics, phase relations, and origin of igneous and metamorphic rocks. Plate-tectonic setting of magmatism and metamorphism.Laboratory emphasizes physical properties and identification of minerals and rocks in hand sample and thin section. The key course requirement for a major. *Prerequisites: Introductory chemistry (***Chemistry 8/9***) and* **EES 40** *or permission of instructor. Lab.*

180 Sedimentology and Stratigraphy
Depositional systems and sedimentary processes. Facies models, succession, age relationships and correlation of strata. Petrology and provenance of sedimentary rocks. *Prerequisites:* **EES 40** *or* **EES 160** *or equivalent or permission of instructor. Lab and field trips.*

185 Geologic Field Methods
Introduction to geologic field methods and instruments, use of aerial photographs and topographic maps in geologic mapping, preparation of geologic maps of local areas. *Prerequisites:* **EES 40** *and two upper-division courses or permission of the instructor. One hour lecture, six hours field. Summer Session offering.*

190 Structural and Regional Geology
Geometric, kinematic and dynamic analysis of structures of igneous, sedimentary and metamorphic rocks. Laboratory emphasis on descriptive geometry and stereographic solutions to structural problems; geologic maps and structure sections. *Prerequisite:* **EES 40** *or permission of instructor. Lab and field trips.*

195 Internship
This course is open only to our majors and is typically taken by a junior or senior student who wishes to advance their education with related work experience and is maintaining at least a 2.5 GPA. In addition to the internship hours (6–8 hours per week) outside research and a term project are required. Permission of an instructor/mentor of record and the department chair are required.

196 Senior Project (.25 credit)
This is a capstone course for our majors and is typically completed in a student's senior year that requires students to move from a more theoretical understanding of environmental/earth science to the integration of concepts and material from within their entire course of study. Typically students will propose and carry out an independent research project in their area of interest, under the mentorship/council of a faculty member. *Permission of an instructor/mentor of record and the department chair are required.*

197 Independent Study
An independent study or research project course open only to our majors, typically taken during junior or senior year. Students plan and carry out environmental science research with a faculty mentor. Permission of the instructor/mentor and the department chair are required. *Laboratory fee, when appropriate is $175.*